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(54) A lubricant and process for its production.

(57) An improved lubricant is described which contains mineral or synthetic oils and lubricant concentrates, and as additives contains two heavy metal compounds as well as a metal and sulfur-free phosphorus compound. The synthesis of the lubricants is also described.

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A Lubricant and Process for its Production

The invention relates to a lubricant consisting essentially of mineral or synthetic oils or lubricant concentrate and additives in the form of heavy metal organic compounds and phosphorus compounds.

It is known that for producing lubricants, mineral or synthetic oils can be provided with additives in order to increase their loadability and oxidation resistance, to improve their adherence, and to limit their heating under friction. Lubricants of the type mentioned above are described in DE-C-2 108 780. However, it has been found that such known lubricants can still be further improved in view of abrasion and area pressure.

The object of the invention is to provide a lubricant having better abrasion values and permitting a higher area pressure.

According to the invention the lubricant comprises compounds of two heavy metals as well as a metal- and sulfur-free organic phosphorus compound as additives.

The lubricant according to the invention can be formulated on the base of ordinary lubricating oils or lubricant concentrates, e.g. from mineral or synthetic oils such as paraffin oils.

Two heavy metal compounds, preferably from the group of compounds of molybdenum, zinc, tungsten, and vanadium, are provided in the lubricant according to the invention. Preferred combinations are compounds of molybdenum and zinc, tungsten and zinc, and vanadium and zinc.

The anions of the two heavy metal compounds are selected such that the compounds are soluble in the lubricating oil or lubricant concentrate used.

Preferred anions are dithiophosphate, in which the oxygen atoms are preferably esterified with alkyl, aryl, and/or aralkyl groups.

Examples of such alkyl groups are those having 1 to 18 carbon atoms, longer-chained straight or branched alkyl groups having 6 to 18 carbon atoms being preferred. For example, alkyl groups having 8 carbon atoms, such as the 2-ethylhexyl groups, may be used.

Examples of aryl groups that may be used are phenyl groups and naphthyl groups which may be substututed by straight or branched alkyl groups, especially with 1 to 6 carbon atoms.

Examples of aralkyl groups are the above-mentioned alkyl groups which are substituted by the above-mentioned aryl groups.

Special examples of the heavy metal compounds that may be used are molybdenum and zinc dialkyldithiophosphoric acid esters, e.g. molybdenum and zinc-di-2-ethylhexyl-dithiophosphoric acid esters, a combination of the two latter compounds being especially preferred.

The heavy metal compounds may also be present as a dithiocarbamate, molybdenum dithiocarbamate being especially preferred. A preferred composition is molybdenum dithiocarbamate together with a zinc dialkyldithiophosphate, e.g. zinc-di-2-ethylhexyldithiophosphoric acid ester.

The third component according to the invention besides the two heavy metal compounds is an organic phosphorus compound free of metal and sulfur. An organic phosphate, especially a trialkyl or triaryl phosphate, is especially well suited, examples of alkyl and aryl groups being the alkyl and aryl groups defined above.

Especially preferred triaryl phosphates are for instance natural phosphates from the distillation of coal tar, such as trixylylphosphate, tritolylphosphate, tricresylphosphate and especially synthetic phosphates, such as alkylphenyl phosphates in which the phenyl radical is substituted by 1 to 3 alkyl groups with 1 to 6 carbon atoms, especially with branched alkyl groups with 3 or 4 carbon atoms, such as the isopropyl groups or sec. or tert.butyl group. An especially well suited example is triisopropylphenyl phosphate.

The above mentioned three constituents (two heavy metal compounds and metal-and sulfur-free phosphate compounds) are preferable present in weight ratios from 0.1-1.5:0.1-1.5:0.1-1.5, preferably in the weight ratio of about 1:1:1, to each other in the lubricant. Their total weight (sum of the three constituents) in the finished lubricant preferably amounts to 3 to 10%, especially favorable 3.9 to 9.9%, particularly 5.9 to 7.9%, and is, for example, about 6.9%.

Especially preferred compositions contain 3.9 to 9.9 wt.% and especially 6.9 wt.% molybdenum-di-2-ethylhexyl dithiophosphoric acid ester and/or molybdenum-dithiocarbamate, together with zinc-di-2-ethyl-hexyldithio phosphoric acid ester and triisopropylphenylphosphate, the molybdenum, zinc, and phosphate compounds being present in weight ratios of approx. 1:1:1.

The lubricant according to the invention may, naturally, contain also conventional additives. Examples of such additives are ordinary cholate formers, which passivate undesired copper fractions, for example, as well as other ordinary corrosion inhibitors, adhesion improvers based on polymers, e.g. based on polymethacrylate and corresponding viscosity index improvers as well as ordinary antirusting agents such as barium dinonylnaphthalene sulfonate, and defoamers.

The lubricant of the invention can be synthesized by mixing the individual constituents. For example, the additives are stirred seperately into the oils heated from room temperature to about 100°C, e.g. about 50°C.

The following examples serve to illustrate the synthetic and compositions of the lubricants according to the invention.

Example 1

A lubricant was produced from the following components:

Mineral oil component	915.0 kg
290.7 kg HR80 .	
624.3 KG Brightstock 406	
Copper passivator (commercial product Reomet 38)	1.0 kg
Triarylphosphate (isopropylphenylphosphate) (commercial product Refos 95)	23.0 kg
Molybdenum-di-2-ethylhexyl-dithiophosphoric acid ester (commercial product Molyvan L)	23.0 kg
2-ethylhexyl zinc dithiophosphate (commercial product RC3180)	23.0 kg
Polymethacrylate (for lowering the flow point) (commercial product Hitec E 603)	5.0 kg
Bariumdinonyl naphthalenesulfonate (corrosion inhibitor, commercial product Na-Sul BSN)	10.0 kg

The above-named additives were stirred in seperately after hesting of the two paraffin oils to 50°C, using 50 g of an ordinary defoamer. After the addition of the last additive, stirring continued for another 20 min.

Example 2

Example 1 was repeated, but this time the molybdenum-di-2-ethylhexyldithiophosphate was replaced by molybdenum-dithiocarbamate.

Measurements with a vibrating friction-abrasion machine (SRV machine) showed that the lubricants according to the invention provide improved abrasion values and improved area pressure.

Thus it is possible with the compositions according to the invention to omit ordinary sulfur additives. In addition, sperm oil and terpene are no longer required as additives, which substantially contributes to improving the abrasion values and area pressure.

The merrits of the present invention are further explained by means of the following comparative examples.

Comparative examples:

Example 1:

In a laboratory test three known transmission lubricant oils A, B and C have been examined and compared with a transmission lubricant oil of the present invention by means of a SRV-test apparatus. The SRV-test apparatus is an apparatus which is able to determine properties of oils like wear values and surface or contact pressure in accordance with the swing-friction-wear (SRV)-method.

In a stepwise application of load of the oil from 100 N for three minutes up to 800 N for two minutes, a swinging-amplitude of 1.000 u, a frequenz of 50 Hz and a temperature of 70°C, the lubricant oil A seized after seven minutes, ten seconds; the lubricant oil B after 13 minutes, 10 seconds; and the lubricant oil C after 13 minutes, 50 seconds, while the lubricant oil of the present invention sustained without trouble more than eight hours of the test strain. The composition of oil C is disclosed in DE-C-2 108 780.

Example 2:

In a practical test the friction moment of an axial-self-aligning roller bearing has been checked at variable axial load and variable rotational speed.

In this test, two known EP-lubricants and a lubricant of the present invention have been tested, and in particular under extreme conditions like low rotational speed and high load, i.e. at very unfavorable operational conditions and extremely unfavorable friction moments. The values obtained with the lubricant of the present invention have been up to 55 % better than those of the normal additivated comparative - lubricants.

At a second test the break up or separation moment has been checked under variable loads. The friction moment values of the lubricant of the present invention have been up to 65 % lower than those of normal EP-lubricants at friction limits and variable friction.

Claims

1. A lubricant on the basis of mineral or synthetic oils or lubricant concentrates with additives in the form of heavy metal organic compounds and phosphorus compounds, characterized in that it contains, as additives, compounds of two heavy metals and one metal-and sulfur-free phosphorus compound.

2. Lubricant as claimed in claim 1, characterized in that the organic phosphorus compound is a triarylphosphate.

3. Lubricant as claimed in claim 1 or 2, characterized in that the two heavy metal compounds are selected from the compounds of metals of the group of molybdenum, zinc, tungsten, and vanadium, that are soluble in the lubricating oil.

4. Lubricant as claimed in anyone of claims 1 to 3, characterized in that the two heavy metal compounds are alkyl, aryl and/or aralkyl dithiophosphates of the heavy metals.

5. Lubricant as claimed in anyone of claims 1 to 4, characterized in that the two heavy metal compounds are mlybdenum and zinc dithiophosphates.

6. Lubricant as claimed in anyone of claims 1 to 5, characterized in that the three additives (the two heavy metal compounds and the metal and sulfur-free organic phosphorus compounds) are present in a weight ratio of 0.5 - 1.5; 0.5 - 1.5 : 0.5 - 1.5 and especially in a weight ratio of about 1:1:1.

7. Lubricant as claimed in anyone of claims 1 to 6, characterized in that the three additives (two heavy metal compounds and metal-and sulfur-free organic phosphorus compounds) are present in a weight proportion of 3 to 10 % in the finished lubricant.

8. Lubricant as claimed in anyone of claims 1 to 7, characterized in that one of the heavy metal compounds is present in the form of a dithiocarbamate.

9. Lubricant as claimed in anyone of claims 1 to 8, characterized in that one of the heavy metal compounds is molybdenum dithiocarbamate.

10. Lubricant as claimed in anyone of the preceeding claims, characterized in that the two heavy metal compounds are molybdenum dithiocarbamate and a zinc dithiophosphate.

11. Process for producing a lubricant as claimed in anyone of the preceeding claims, characterized in that the mineral or synthetic base oils or lubricant concentrates are heated to a temperature from 25° to 100°C, and the two heavy metal compounds as well as the metal-free and sulfur-free phosphorus compounds are stirred in successively until dissolution is achieved.